

heating positions were adopted. The experimental results showed that at high CO setting levels, less heating energy was required from the heaters to induce self-initiated reaction of the catalyst. It was also observed that a high total input energy led to a high CO conversion efficiency. Heating at the inlet of the catalyst has also the same effect. When a high heating temperature was coupled with a high CO setting level, self-initiated reaction of the catalyst was easily achieved.

06/00281 Evolution strategy for gas-turbine fault-diagnoses

Ogaji, S. O. T. *et al. Applied Energy*, 2005, 81, (2), 222–230.

The aim of this investigation is to be able to diagnose gas-path faults in gas turbines by minimizing the differences between the observed and simulated data for the engine's behaviour. The simulated data are generated using a known set of faults as the input to the engine-behaviour aero-thermo model and an appropriate objective function is minimized to yield the best solution to the problem. The application of evolution strategy (ES) in the search for this minimum is an effective, flexible, robust and reliable way of solving engine-diagnostics problems. Adopting this approach leads to a considerable reduction in the overall time taken to obtain a convergent solution when compared with that required using a simple genetic-based algorithm.

06/00282 Experimental and theoretical investigation of using gasoline-ethanol blends in spark-ignition engines

Bayraktar, H. *Renewable Energy*, 2005, 30, (11), 1733–1747.

The effects of ethanol addition to gasoline on an SI engine performance and exhaust emissions are investigated experimentally and theoretically. In the theoretical study, a quasi-dimensional SI engine cycle model, which was firstly developed for gasoline-fuelled SI engines by author, has been adapted for SI engines running on gasoline-ethanol blends. Experimental applications have been carried out with the blends containing 1.5, 3, 4.5, 6, 7.5, 9, 10.5 and 12 vol% ethanol. Numerical applications have been performed up to 21 vol% ethanol. Engine was operated with each blend at 1500 rpm for compression ratios of 7.75 and 8.25 and at full throttle setting. Results obtained from both theoretical and experimental studies are compared graphically. Experimental results have shown that among the various blends, the blend of 7.5% ethanol was the most suitable one from the engine performance and CO emissions points of view. However, theoretical comparisons have shown that the blend containing 16.5% ethanol was the most suited blend for SI engines. Furthermore, it was demonstrated that the proposed SI engine cycle model has an ability of computing SI engine cycles when using ethanol and ethanol-gasoline blends and it can be used for further extensive parametric studies.

06/00283 Investigating the effects of LPG on spark ignition engine combustion and performance

Bayraktar, H. and Durgun, O. *Energy Conversion and Management*, 2005, 46, (13–14), 2317–2333.

A quasi-dimensional spark ignition (SI) engine cycle model is used to predict the cycle, performance and exhaust emissions of an automotive engine for the cases of using gasoline and LPG. Governing equations of the mathematical model mainly consist of first-order ordinary differential equations derived for cylinder pressure and temperature. Combustion is simulated as a turbulent flame propagation process and during this process, two different thermodynamic regions consisting of unburned gases and burned gases that are separated by the flame front are considered. A computer code for the cycle model has been prepared to perform numerical calculations over a range of engine speeds and fuel-air equivalence ratios. In the computations performed at different engine speeds, the same fuel-air equivalence ratios are selected for each fuel to make realistic comparisons from the fuel economy and fuel consumption points of view. Comparisons show that if LPG-fuelled SI engines are operated at the same conditions with those of gasoline fuelled SI engines, significant improvements in exhaust emissions can be achieved. However, variations in various engine performance parameters and the effects on the engine structural elements are not promising.

06/00284 Modeling and simulation of ac-dc buck-boost converter fed dc motor with uniform PWM technique

Ahmed, N. A. *Electric Power Systems Research*, 2005, 73, (3), 363–372. PWM controlled rectifiers can efficiently and economically be employed in low and medium power applications of dc drives and in front-end converters of rectifier-inverter systems while maintaining the advantages of design simplicity and operation reliability of naturally commutated schemes. Due to the high dc voltage that is produced which is greater than the peak voltage of the utility supply, the ac-dc buck-boost converter is especially suited as a front-end power source in variable-speed drive systems to convert the utility supply voltage into a variable dc link voltage where a single-phase or a three-phase utilities power supply is available. In this paper, the dynamic model and steady state equivalent circuit of a single-phase ac-dc buck-boost converter fed dc motor with uniform PWM control is presented. The waveforms

of voltage and current, the input and output characteristics of the converter are discussed and verified. Measured, computed and simulated results are shown to be very close and the model is proved to be efficient and accurate.

06/00285 Modeling, numerical optimization, and irreversibility reduction of a dual-pressure reheat combined-cycle

Bassily, A. M. *Applied Energy*, 2005, 81, (2), 127–151.

Optimizing the gas-turbine combined-cycle is an important method for improving its efficiency. In this paper, a dual-pressure reheat combined-cycle was modelled and optimized for 80 cases. Constraints were set on the minimum temperature-difference for pinch points (PPm), superheat approach temperature-difference, steam-turbine inlet temperature and pressure, stack temperature, and dryness fraction at the steam-turbine's outlet. The dual-pressure reheat combined-cycle was optimized using two different methods; the direct search and the variable metric. A technique to reduce the irreversibility of the steam generator of the combined cycle was introduced. The optimized and the reduced-irreversibility dual-pressure reheat combined-cycles were compared with the regularly-designed dual-pressure reheat combined-cycle, which is the typical design for a commercial combined-cycle. The effects of varying the inlet temperature of the gas turbine (TIT) and PPm on the performance of all cycles were presented and discussed. The results indicated that the optimized combined-cycle is up to 1% higher in efficiency than the reduced-irreversibility combined-cycle, which is 2–2.5% higher in efficiency than the regularly-designed combined-cycle when compared for the same values of TIT and PPm. The advantages of the optimized and reduced-irreversibility combined-cycles were manifested when compared with the most efficient commercially-available combined cycle at the same value of TIT.

06/00286 Optimal performance of a generalized irreversible Carnot-engine

Zhou, S. *et al. Applied Energy*, 2005, 81, (4), 376–387.

This paper presents a generalized irreversible Carnot-engine model that incorporates several internal and external irreversibilities, such as heat-resistance, bypass heat-leak, friction and turbulence. The added irreversibilities besides heat-resistance are characterized by a constant parameter and a constant coefficient. The relation between optimal power-output and efficiency is derived based on a generalized heat-transfer law $q \propto (\Delta T)^n$. Detailed numerical examples show the effect of bypass heat-leakage, internal irreversibility and heat-transfer law on the optimal performance of the generalized irreversible heat-engine.

06/00287 Optimum absorber temperature of a once-reflecting full conical concentrator of a low temperature differential Stirling engine

Kongtragool, B. and Wongwises, S. *Renewable Energy*, 2005, 30, (11), 1671–1687.

This paper provides a theoretical investigation on the optimum absorber temperature of a once-reflecting full conical concentrator for maximizing overall efficiency of a solar-powered low temperature differential Stirling engine. A mathematical model for the overall efficiency of the solar-powered Stirling engine is developed. The optimum absorber temperature for maximum overall efficiency for both limiting conditions of maximum possible engine efficiency and maximum possible engine power output is determined. The results indicated that the optimum absorber temperatures calculated from these two limiting cases are not significantly different. For a given concentrated solar intensity, the maximum overall efficiency characterized by the condition of maximum possible engine power output is very close to that of the real engine of 55% Carnot efficiency, approximately.

06/00288 Performance maps of a diesel engine

Çelik, V. and Arcaklioglu, E. *Applied Energy*, 2005, 81, (3), 247–259.

This paper suggests a mechanism for determining the constant specific-fuel consumption curves of a diesel engine using artificial neural-networks (ANNs). In addition, fuel-air equivalence ratio and exhaust temperature values have been predicted with the ANN. To train the ANN, experimental results have been used, performed for three cooling-water temperatures 70, 80, 90, and 100°C for the engine powers ranging from 1000 to 2300 – for six different powers of 75–450 kW with incremental steps of 75 kW. In the network, the back-propagation learning algorithm with two different variants, single hidden-layer, and logistic sigmoid transfer function have been used. Cooling water-temperature, engine speed and engine power have been used as the input layer, while the exhaust temperature, break specific-fuel consumption (BSFC, g/kWh) and fuel-air equivalence ratio (FAR) have also been used separately as the output layer. It is shown that R^2 values are about 0.99 for the training and test data; RMS values are smaller than 0.03; and mean errors are smaller than 5.5% for the test data.